

SEED AND LEAF GALL NEMATODES OF THE GENUS
ANGUINA OCCURRING IN NORTH AMERICA

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Introduction

Seed gall nematodes were the first plant parasitic nematodes to be observed and described. In 1743 a Catholic clergyman, Turbevill Needham, observed Anguina tritici in wheat seed galls and reported his observation to the Royal Society of London. This is thought to be the first recorded microscopic observation in which the observer associated a pathogenic organism as the causal agent of a plant disease. Currently 28 species of Anguina have been described. Species of Anguina are not known to occur in Florida, but several species have been reported in nearby states. The 9 species that have been reported in North America are discussed in this circular.

Anguina tritici (Steinbuch) Filipjev

Life Cycle and Symptoms: Initial infection of young seedlings occurs from larvae which are found in seed galls or in the soil. The larvae feed as

ectoparasites between young leaves near the growing point. Infected leaves become wrinkled with curled edges, and the stem becomes bent and distorted (fig. 1A). When flower primordia form, the larvae penetrate these tissues and alter seed development. Infected seed are smaller than normal grain (fig. 1B). Diseased heads of wheat are usually shorter than healthy ones, and the normal symmetry of the head is destroyed because the galls force the glumes to spread apart and alter the position of awns (fig. 1C). Several galls may be found in the place of a single grain. Diseased heads remain green longer than healthy heads, and at maturity galls of wheat turn dark brown. A gall may contain many mature males and females. Since each female may lay as many as 2,000 eggs, a very large number of second stage larvae may occur in a single gall. Up to 30,000 larvae per gall are common, and as many as 90,000 have been reported in a large gall. Larvae can endure desiccation for long periods, during which time they remain dormant. Larvae have been revived from dried galls that had been stored under laboratory conditions for 37 years (1,4).

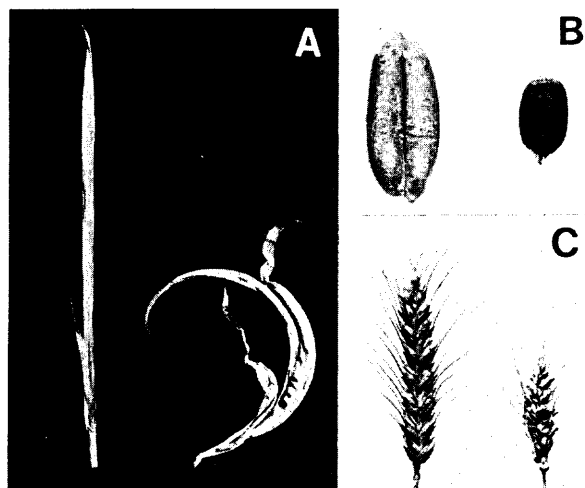


Fig. 1. Symptoms on wheat caused by Anguina tritici. A) Normal leaf (left), twisted emerging leaf (right). B) Normal seed (left), galled seed (right). C) Normal head (left), diseased head (right). (Photo C from Leukel, USDA)

Hosts and Geographic Distribution: Anguina tritici occurs in major cereal growing regions throughout the world. In southeastern United States it has been reported in Virginia, North Carolina, South Carolina, and Georgia. The most frequent host is Triticum aestivum L. (wheat), but A. tritici also may be a problem on Secale cereale L. (rye), Triticum dicoccum Schrank (emmer), and Triticum spelta L. (spelt) (1,4).

Losses and Control: Formerly this nematode caused heavy economic losses. Severe outbreaks in wheat and rye have resulted in losses up to 50% and 65%, respectively (1). In recent years, this nematode has not been a problem where modern seed-cleaning techniques that separate galls from healthy grains are practiced. In 1745, Needham recorded the suggestion of a Mr. Bradley for separating galls from grain by flotation in brine. This was the first recorded recommendation ever made for control of a plant parasitic nematode, and for many years this was the recommended control measure for this nematode (4).

Anguina agrostis (Steinbuch) Filipjev

Life Cycle and Symptoms: Second-stage larvae from galls or soil move in a water film to the growing point of young plants, where they feed. When inflorescences form, they enter tissue of developing ovules and stimulate the production of modified seed structures, resulting in galls. Here the third and fourth stage larvae and the adult nematodes develop. Unlike galls caused by A. tritici which are

smaller than normal seeds, gall inflorescences infected with A. agrostis have glumes that are 4 to 5 times longer than normal. The appearance of severely infected inflorescences is modified to the extent that, infected plants were described in error as a new species of grass (3).

Hosts and Geographic Distribution: The most common hosts are various types of bentgrass in the genus Agrostis. Twelve other genera of grasses are hosts. Anguina agrostis, like A. tritici has a wide distribution and has been reported in the Pacific northwest of the continental United States, Alaska, Canada, various European countries, United Kingdom, Australia, New Zealand, and the USSR (3).

Losses and Control: Anguina agrostis is a potentially important pest where bentgrasses are grown for seed. Nematodes are spread to new areas by harvesting machinery, by movement of crop refuse, or by contaminated seed. Hot water and chemical seed treatments have been used to produce clean seed. Because the nematodes do not survive in the soil for more than one year, they can be eliminated by crop rotation or fallow. The use of herbicides to prevent flower formation of bentgrasses has also been effective in control, since the larvae only develop to maturity inside the seed galls (3).

Additional Species of Anguina Found in North America

In addition to A. tritici and A. agrostis, 7 other species of Anguina occur in North America (table 1). These 7 species are presently considered to be of minor economic importance. They occur on many types of hosts. Some species only cause leaf or stem galls and do not infect inflorescences (2,4,5,6).

Table 1. Species of Anguina Occurring in North America Which Are of Minor Economic Importance

<u>Species and Author</u>	<u>Principal Hosts</u>	<u>Principal Symptoms</u>	<u>Distribution</u>
<u>A. agropyronifloris</u> Norton	<u>Agropyron smithii</u> Rydb. (western bentgrass)	Galls are longer and narrower than normal seed	U.S. (MT, KS, and SD)
<u>A. amsinckia</u> (Filipjev and Stekhoven) Thorne	<u>Amsinckia intermedia</u> F. and M. (fiddleneck)	Galls on stems and seed heads	U.S. (CA)
<u>A. balsamophila</u> (Thorne) Filipjev	<u>Balsamorhiza sagittata</u> , (Pursh) Nutt., (arrowleaf-balsaroot)	Purplish galls on leaves	U.S. (UT, CA, CO, WA, and ID)
<u>A. calamagrostis</u> Wu	<u>Calamagrostis canadensis</u> (Michx.) Nutt., (bluejoint grass)	Galls at base of leaves	Canada (Ontario, and Quebec) and U.S. (WI)
<u>A. graminophila</u> (Goodey) Filipjev	<u>Agrostis alba</u> L. (fine bentgrass)	Galls at base of leaves, 1-15 mm long	U.S. (OR, MN), Germany and England
<u>A. plantaginis</u> Hirschmann	<u>Plantago aristata</u> Michx. (bracted plantain)	Galled inflorescences and leaves	U.S. (NC, SC, and AL)
<u>A. pustulicola</u> (Thorne) Goodey	(unidentified grasses)	Galls on stems	Mexico

Survey and Detection

- 1) Anguina species may cause abnormal-sized seeds, or galled inflorescences, galled leaf tissue, and twisted stems.
- 2) Cereal crops and other grasses are the most common hosts, but Anguina spp. are known to infect many types of monocotyledons and dicotyledons. Leaf galls may appear similar to galls caused by insects.
- 3) Seeds or foliage with symptoms should preferably be submitted fresh, but they may also be submitted dry, since these nematodes can withstand desiccation.

Selected References

1. Leukel, R. W. 1957. The nematode diseases of wheat and rye. USDA Farmers' Bull. 1607 (revised). 16p.
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